UM10729

PCA9955A demonstration board OM13483

Rev. 1 — 23 July 2014 **User manual**

Document information

Info	Content
Keywords	Fm+ I2C-bus, PCA9955A, RGB and White LEDs, 16-channel x 8-bit PWMs
Abstract	The OM13483 is an add-on to 9-pin connector of the NXP I2C demo board 2005-1 or Fm+ I^2C-bus development board. This daughter board makes it easy to test and design with the PCA9955A, a 16-channel Fast-mode Plus (Fm+) 57 mA constant current and outputs allow up to 20 V for LED supply. This demo board, along with the Win-I2CUSB Lite GUI (PC based), provides an easy to use evaluation platform.

Revision history

Rev	Date	Description
1.0	20140723	User manual; initial release.

Contact information

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1. Introduction

The PCA9955A evaluation board features LEDs for color mixing, blinking and dimming demonstrations. A graphical interface allows the user to explore the different functions of the driver easily. The board can be connected in series with other I^2C demo-boards to create an evaluation system.

The IC communicates to the host via the industry standard I^2C-bus/SMBus port. The evaluation software runs under Microsoft Windows PC platform.

2. Features

- A complete evaluation platform for the PCA9955A 16-channel Fm+ I^2C-bus constant current LED driver
- Easy to use GUI-based software demonstrates the capabilities of the PCA9955A
- On-board four white and four RGB LEDs for visual experience
- Convenient test points for easy scope measurements and signal access
- USB interface to the host PC
- No external power supply required

3. Getting started

3.1 Assumptions

Familiarity with the I^2C-bus is helpful, but not required.

3.2 Static handling requirements

CAUTION

This device is sensitive to ElectroStatic Discharge (ESD). Therefore care should be taken during transport and handling. You must use a ground strap or touch the PC case or other grounded source before unpacking or handling the hardware.

3.3 Minimum system requirements

- PC Pentium 60 processor (or equivalent), 8 MB RAM, 10 MB of hard drive space
- One USB port (either 2.0 or 1.1 compatible)
- Windows 98SE, ME, 2000, XP, or Vista
- I2C demonstration board 2005-1 (OM6275) or Win-I2CUSB board (from www.demoboard.com)

3.4 Power requirements

The NXP demonstration board I2C 2005-1 and OM13483 hardware obtain power from the PC USB port. Care should be taken not to exceed the USB port current capabilities.

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4. Installation

4.1 I2C demo board 2005-1 and Win-I2CUSB Lite software

The OM13483 is a daughter card to the OM6275 I^2C demo board 2005-1. You may download the Win-I2CUSB Lite Software, the OM6275 user manual UM10206, and find ordering information at the NXP web site www.nxp.com/demoboard/OM6275.html.

The OM13483 is a daughter card to the OM13260 Fm+ I^2C-bus development board, which is part of the Fm+ development board kit (OM13320). You may download the software, user manual, and find ordering information at the NXP web site: www.nxp.com/demoboard/OM13320.html#documentation.

The Win-I2CUSB Lite software from The Boardshop runs on Windows 98SE, ME, 2000, and XP and is compatible with any PC hardware having a minimum of a Pentium processor and a USB port. The software allows the user to select one of the I^2C-bus devices on the board from a menu. It also provides a Universal mode (I^2C Expert mode) to allow users to create their own I^2C-bus commands with the same I^2C-bus devices.

4.2 OM13483 connection to I2C demo board 2005-1

The I2C demo board 2005-1 should be disconnected from your PC before mounting the OM13483 board on to it. The OM13483 board has a 9-pin female connector (CON2) that connects to the JP1 male connector on the I2C demo board 2005-1 as shown in Figure 1.

With both boards facing you, and with USB connector on the right-hand side as shown in Figure 1, connect the OM13483 board to the I2C demo board 2005-1 before connecting the USB cable. Once the board is connected, connect the USB cable and start the Win-I2CUSB Lite software. You are now ready to evaluate the PCA9955A.

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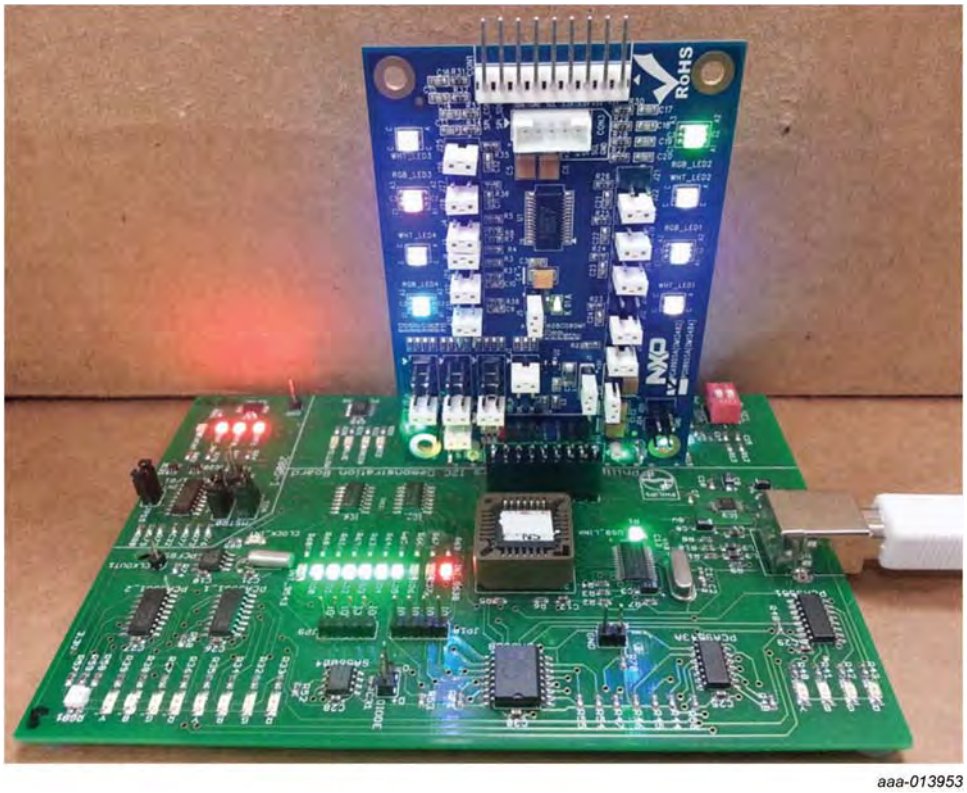

Fig 1. PCA9955A demo board (OM13483) mounting to the I2C demo board 2005-1 (OM6275)

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4.3 OM13483 connection to Fm+ I2C bus development board

The OM13260 Fm+ I2C bus development board should be disconnected from your PC before mounting the OM13483 board onto it. The OM13483 board has a 9-pin female connector (CON2) that connects to the CN2 male connector on the bridge board (OM13399) as shown in Figure 2.

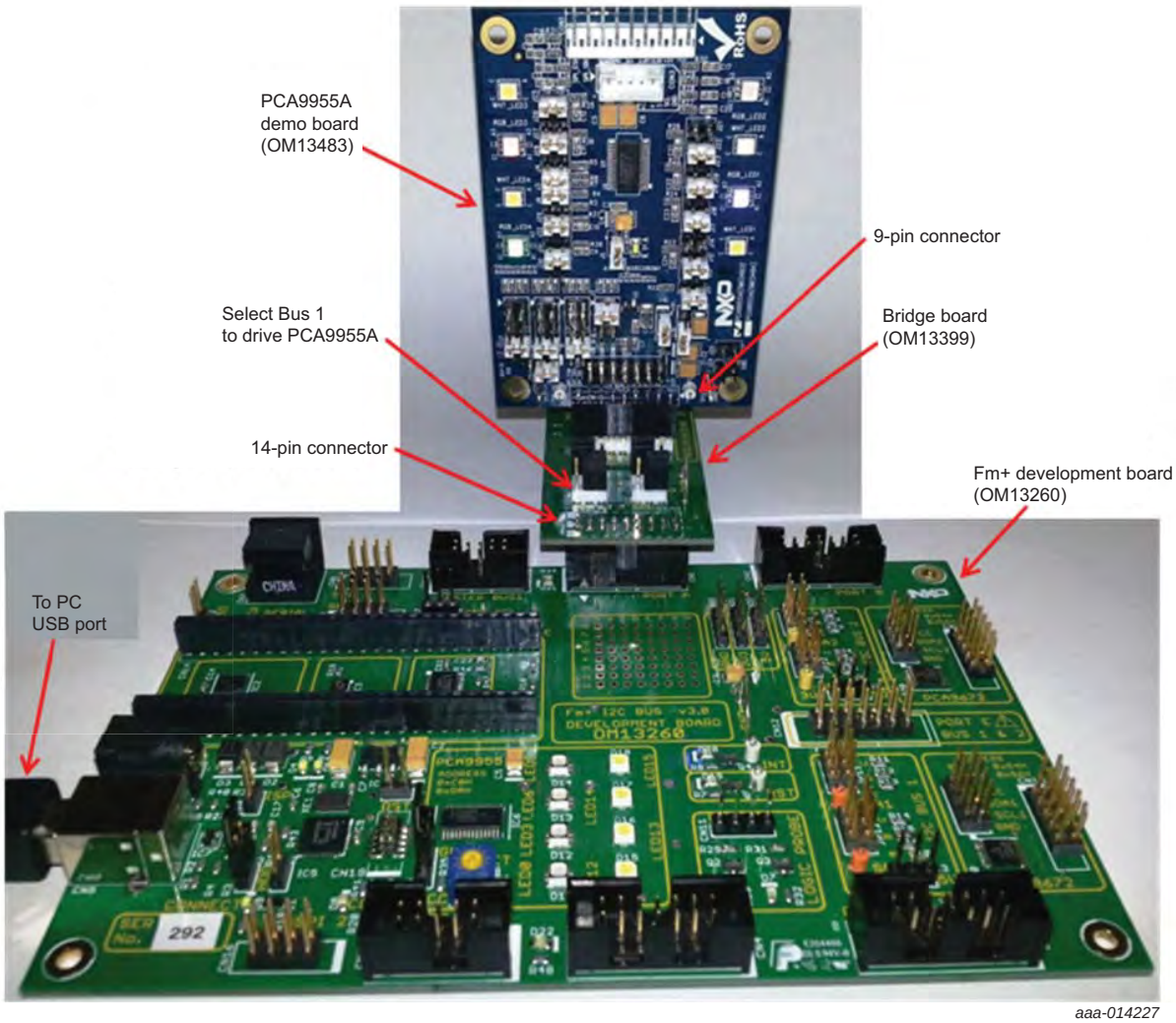

Fig 2. PCA9955A demo board (OM13483) mounting to the Fm+ development board (OM13260)

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4.4 OM13483 connection to Win-I2CUSB hardware adapter board

The Win-I2CUSB board should be disconnected from your PC before connecting the OM13483 board on to it. The OM13483 board has a 14-pin male connector (CON4) that connects to the 14-pin male connector (J1) on the Win-I2CUSB board as shown in Figure 3.

Connect the OM13483 board to the Win-I2CUSB board before connecting the USB cable. Once the board is connected, connect the USB cable and start the Win-I2CUSB Lite software. You are now ready to evaluate the PCA9955A.

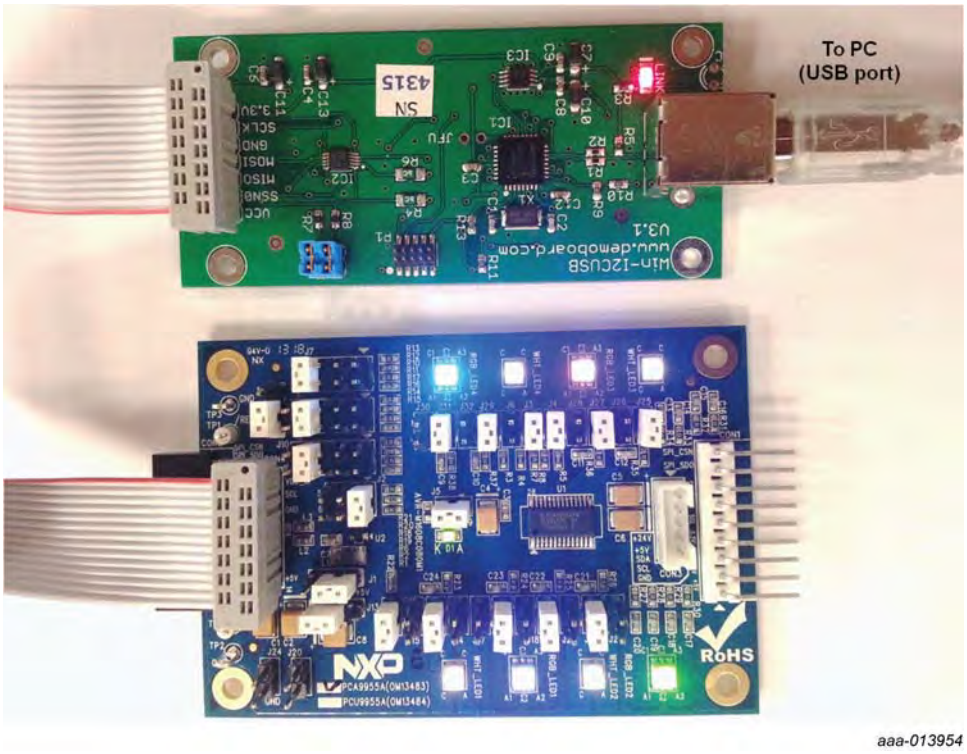

Fig 3. PCA9955A demo board (OM13483) connecting to the Win-I2CUSB board

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5. Hardware description

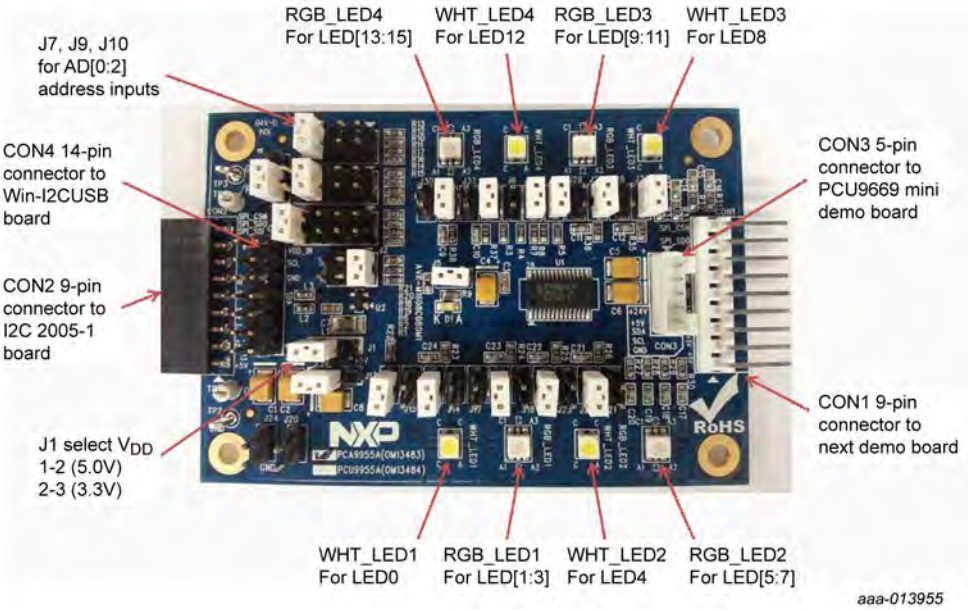

Fig 4. PCA9955A demo board (OM13483)

Figure 4 shows the following items on the hardware:

- CON1 (9-pin male connector) is used to daisy-chain to next I^2C-bus slave device or demo board.
- CON2 (9-pin female connector) is connected to JP1 on I2C demo board 2005-1 as master device to drive this demo board.
- CON3 (5-pin male connector) is connected to the PCU9669 or PCA9665 mini board as I^2C-bus master device to drive this demo board.
- CON4 (14-pin male connector) is connected to J1 on Win-I2CUSB hardware board as I^2C-bus master device to drive this demo board.
- J1 selects V_{DD} power for PCA9955A, connected 1-2 for V_{DD} = 5 V and connected 2-3 for V_{DD} = 3.3 V.
- J7, J9 and J10 to select one of the five (GND, Pull-down, Floating, Pull-up and V_{DD}) input levels to address inputs AD[0:2] for a maximum of 125 possible programmable I^2C-bus slave address.
- LED[0:15] 16-channel output to drive four White LEDs (WHT_LED[1:4]) and four RGB LEDs (RGB_LED[1:4]).
- TP2 and TP3 are GND pins for probing use.
- TP1 can be connected as external reset signal to $\overline{\text{RESET}}$ pin when J6 is open.
- TP4 can be connected as external output enable signal to $\overline{\text{OE}}$ pin for blinking/dimming control when J11 is open.
- All jumpers default setting and function as shown in Table 1.

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Table 1. Jumper settings for test and evaluation

Jumper	Default setting	Comment
J1 (3-pin)	1-2 (V_{DD} = +5 V)	This jumper is used to select V_{DD} for PCU/PCA9955A. **1-2:** select +5 V **2-3:** select +3.3 V
J2 (3 × 2-pin)	1-2 (REXT = 1 kΩ, 57 mA at max.)	This 3 × 2 jumper is used to select REXT (pin 1) value for PCU/PCA9955A. **1-2:** select REXT = 1 kΩ and maximum output current is 57.3 mA **3-4:** select REXT = 1.5 kΩ and maximum output current is 38.25 mA **5-6:** select REXT = 2 kΩ and maximum output current is 28.6 mA
J3 (2-pin)	Short	**Short:** external 1.1 kΩ pull-up resistor for SDA on PCA9955A. **Open:** no external pull-up resistor for SDA on PCA9955A. **Remark:** No external pull-up resistor required for PCU9955A.
J4 (2-pin)	Short	**Short:** external 1.1 kΩ pull-up resistor for SCL on PCA9955A. **Open:** no external pull-up resistor for SCL on PCA9955A. **Remark:** No external pull-up resistor required for PCU9955A.
J5 (2-pin)	Short	**Short:** connect V_{DD} (pin 28) to PCU/PCA9955A. **Open:** connect current meter to measure the I_{DD} on PCU/PCA9955A.
J6 (2-pin)	Open	**Short:** force $\overline{\text{RESET}}$ (pin 25) to GND. **Open:** 10 kΩ pull-up $\overline{\text{RESET}}$ (pin 25) to V_{DD}.
J7 (4 × 2-pin)	7-8[1]	This 4 × 2 jumper is used to select quinary input value for AD0 (pin 2). **Open:** floating **1-2:** select V_{DD} **3-4:** select pull-up with 31.6 kΩ **5-6:** select pull-down with 34.8 kΩ **7-8:** select GND
J8 (3-pin)	1-2	This jumper is used to select bus mode. **1-2:** select normal I^2C or SPI addressable bus mode **2-3:** select SPI daisy-chain bus mode
J9 (5 × 2-pin)	7-8[1]	This 5 × 2 jumper is used to select quinary input value for AD1 (pin 3). **Open:** floating **1-2:** select V_{DD} **3-4:** select pull-up with 31.6 kΩ **5-6:** select pull-down with 34.8 kΩ **7-8:** select GND **9-10:** SDO (Serial Data Out) for SPI addressable mode or last slave device in SPI daisy-chain
J10 (5 × 2-pin)	7-8[1]	This 5 × 2 jumper is used to select quinary input value for AD2 (pin 4). **Open:** floating **1-2:** select V_{DD} **3-4:** select pull-up with 31.6 kΩ **5-6:** select pull-down with 34.8 kΩ **7-8:** select GND **9-10:** CSN (Chip Select) for SPI bus mode
J11 (2-pin)	Short	**Short:** force $\overline{\text{OE}}$ (pin 5) to GND, to enable LEDs output. **Open:** 10 kΩ pull-up $\overline{\text{OE}}$ (pin 5) to V_{DD} when applying external clock for blinking/dimming on TP4 (test point).

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Table 1. Jumper settings for test and evaluation *…continued*

Jumper	Default setting	Comment
J12, J16, J19, J22 (2-pin)	Short	These jumpers are used to open the WHT_LED1 or RGB_LED1 J12 to control White LED, J16 to control Red LED, J19 to control Green LED, J22 to control Blue LED. **Open:** connected the current meter to measure one of the LEDs output current or open one of the LEDs outputs for detecting an LED open condition in one of EFLAGn registers. **Short:** normal operation for WHT_LED1 and RGB_LED1.
J13 (3-pin)	1-2 (V_{LED} = +3.3 V)	This jumper is used to select LED supply voltage. **1-2:** select +3.3 V for all LEDs supply voltage. **2-3:** select +5 V for all LEDs supply voltage. **Open (no jumper):** select external voltage from J20 (≤ +20 V) and J24 (GND)
J14, J18 (2-pin)	Open	These jumpers are used to merge the LED[0:2] outputs together for driving higher LED current. **Open:** normal operation for the LED[0:2]. **Short:** When short J14/J18 and open J16/J19 to combine LED[0:2] outputs to drive LED0. When short J14 only and open J16 to combine LED[0:1] outputs to drive LED0.
J15, J17, J21, J23 (2-pin)	Open	These jumpers are used to short the WHT_LED1 or RGB_LED1 J15 to control White LED, J17 to control Red LED, J23 to control Green LED, J21 to control Blue LED. **Open:** normal operation for WHT_LED1 and RGB_LED1. **Short:** to short one of the LEDs output for detecting an LED short condition in one of EFLAGn registers.
J20 (2-pin)	+20 V input	External ≤ +20 V input for LEDs supply voltage. The J13 is **open** to supply this ≤ +20 V voltage to all LEDs.
J24 (2-pin)	GND	External GND input for LEDs supply voltage.
J25, J27, J29, J31 (2-pin)	Short	These jumpers are used to open the WHT_LED4 or RGB_LED4. J25 to control White LED, J27 to control Red LED, J29 to control Green LED, J31 to control Blue LED. **Open:** connect current meter to measure one of the LEDs output current or open one of the LEDs outputs for detecting an LED open condition in one of EFLAGn registers. **Short:** normal operation for WHT_LED4 and RGB_LED4.
J26, J28, J30, J32 (2-pin)	Open	These jumpers are used to short the WHT_LED4 or RGB_LED4. J26 to control White LED, J28 to control Red LED, J32 to control Green LED, J30 to control Blue LED. **Open:** normal operation for WHT_LED4 and RGB_LED4. **Short:** to one of the LEDs for detecting an LED short condition in one of EFLAGn registers.
CON1	9-pin male connector	This 9-pin connector is used to daisy-chain to next I^2C-bus slave device or demo board.
CON2	9-pin female connector	This 9-pin connector is used to connect to Fm+ I^2C development board or I2C 2005-1 evaluation board as master device to drive this demo board.
CON3	5-pin male connector	This 5-pin connector is used to connect to the PCU9669 or PCA9665 mini board as I^2C-bus master device to drive this demo board.
CON4	14-pin header	This 14-pin header is used to connect to Win-I2CUSB hardware board as I^2C-bus master device to drive this demo board.
TP1	Test Point 1	This TP1 is used to drive $\overline{\text{RESET}}$ input pin 25 from external when J6 is **open**.
TP2, TP3	Test Point 2/3	These two test points are GND for probe ground connection.
TP4	Test Point 4	This TP4 is used to drive $\overline{\text{OE}}$ input pin 5 from external when J11 is **open**.

[1] Default PCU/PCA9955A slave address is 0x02h (AD[2:0] = GND).

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6. Schematic

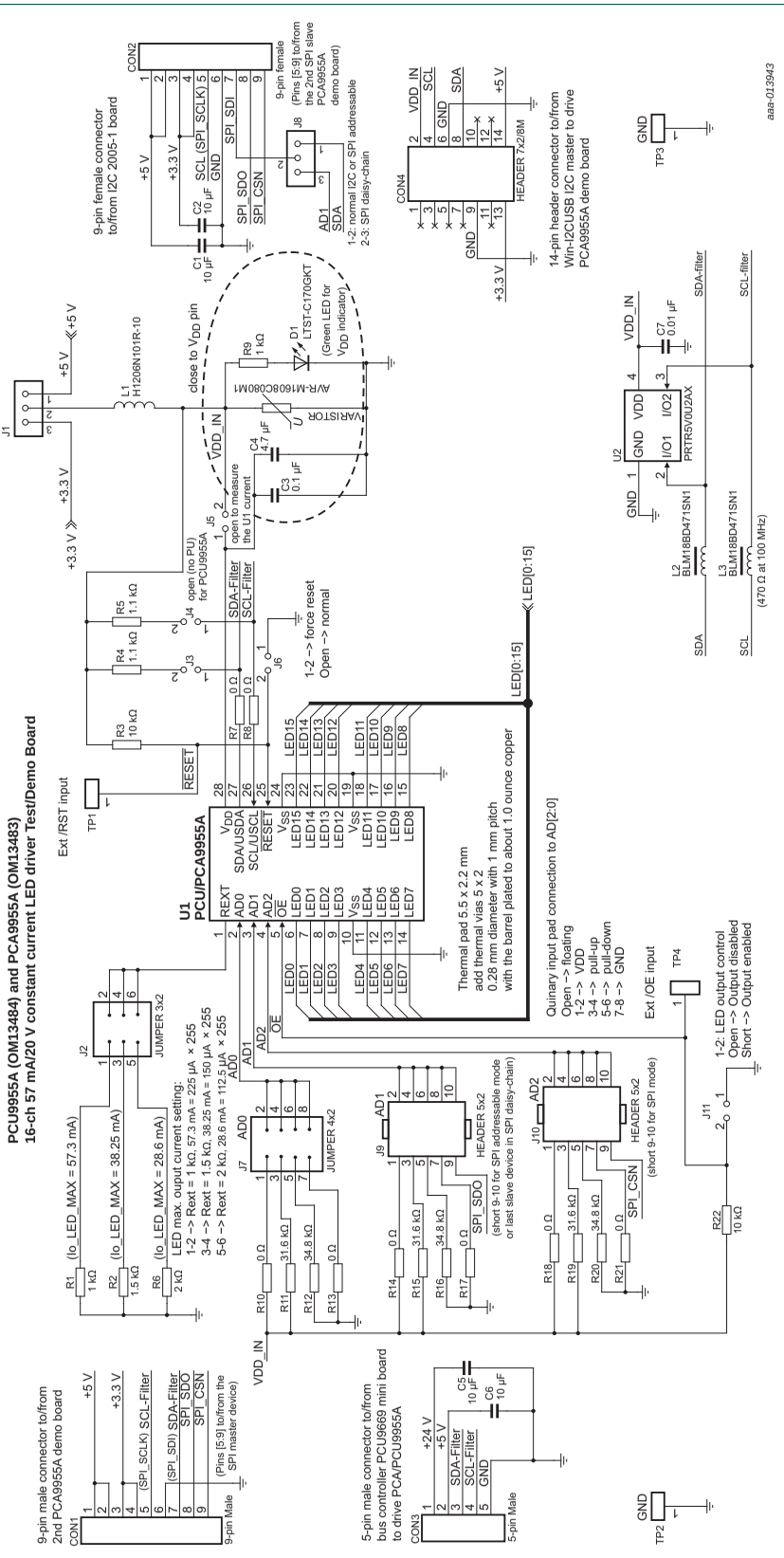
PCU9955A (OM13484) and PCA9955A (OM13483)
16-ch 57 mA/20 V constant current LED driver Test/Demo Board
U1
PCU/PCA9955A
9-pin female connector to/from I2C 2005-1 board
9-pin female
(Pins [5:9] to/from the 2nd SPI slave PCA9955A demo board)
close to VDD pin
(Green LED for VDD indicator)
open to measure the U1 current
open (no PU) for PCU9955A
1-2 --> force reset
Open --> normal
Ext /RST input
Thermal pad 5.5 x 2.2 mm
add thermal vias 5 x 2
0.28 mm diameter with 1 mm pitch
with the barrel plated to about 1.0 ounce copper
Quinary input pad connection to AD[2:0]
Open --> floating
1-2 --> VDD
3-4 --> pull-up
5-6 --> pull-down
7-8 --> GND
Ext /OE input
1-2: LED output control
Open --> Output disabled
Short --> Output enabled
14-pin header connector to/from Win-I2CUSB I2C master to drive PCA9955A demo board
HEADER 7x2/8M
9-pin male connector to/from 2nd PCA9955A demo board
5-pin male connector to/from bus controller PCU9669 mini board to drive PCA/PCU9955A
JUMPER 3x2
JUMPER 4x2
HEADER 5x2
(short 9-10 for SPI addressable mode or last slave device in SPI daisy-chain)
(short 9-10 for SPI mode)
1-2: normal I2C or SPI addressable
2-3: SPI daisy-chain
LED[0:15]
aaa-013943

Fig 5. PCA9955A demo board schematic (part A)

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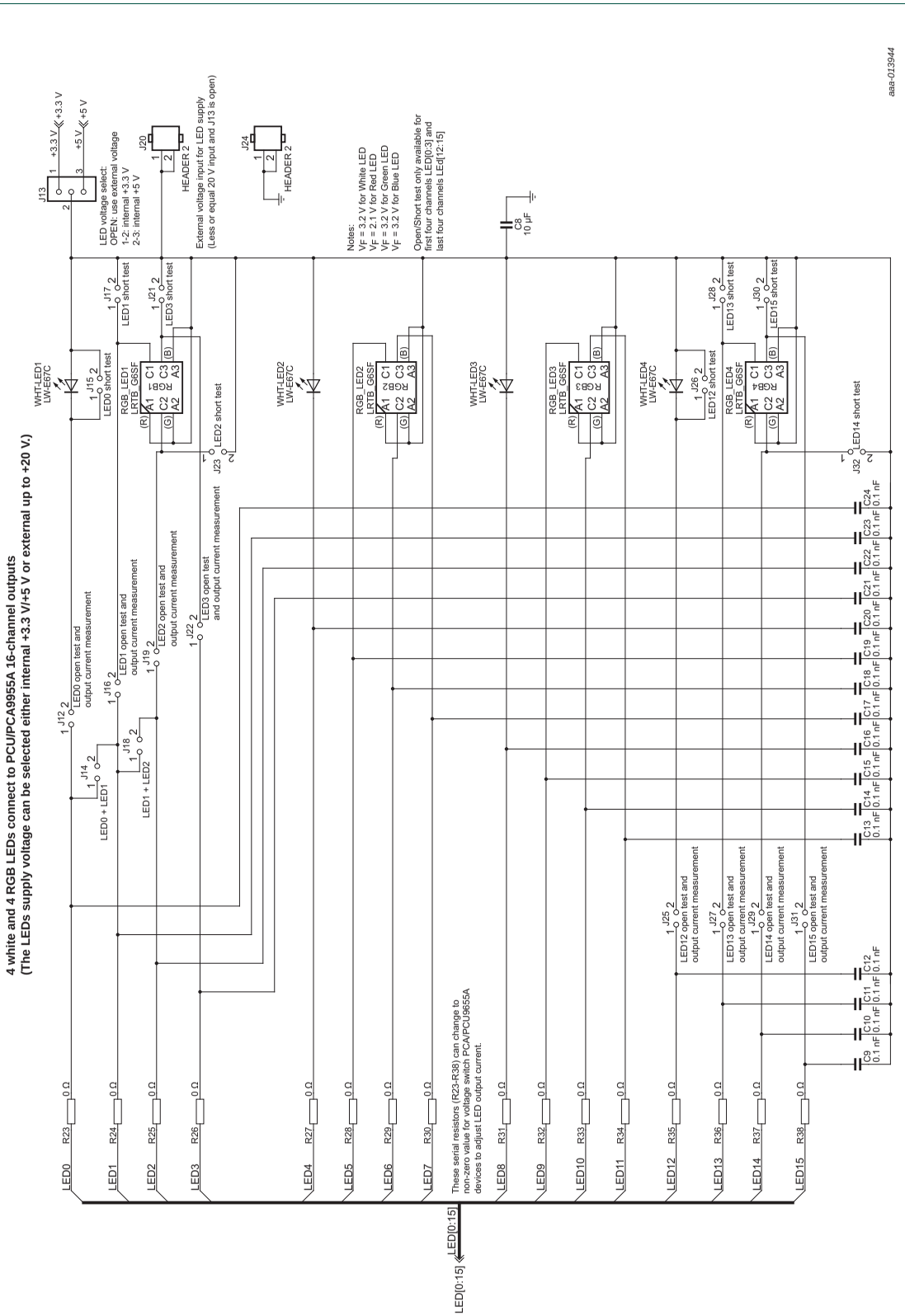
4 white and 4 RGB LEDs connect to PCU/PCA9955A 16-channel outputs
(The LEDs supply voltage can be selected either internal +3.3 V/+5 V or external up to +20 V.)
LED voltage select:
OPEN: use external voltage
1-2: internal +3.3 V
2-3: internal +5 V
External voltage input for LED supply
(Less or equal 20 V input and J13 is open)
Notes:
VF = 3.2 V for White LED
VF = 2.1 V for Red LED
VF = 3.2 V for Green LED
VF = 3.2 V for Blue LED
Open/Short test only available for first four channels LED[0:3] and last four channels LED[12:15]
These serial resistors (R23-R38) can change to non-zero value for voltage switch PCA/PCU9655A devices to adjust LED output current.
LED[0:15]
aaa-013944

Fig 6. PCA9955A demo board schematic (part B)

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7. OM13483 demonstration board main components

Table 2. OM13483 demo board main components

Device	Description	Address/LED	Location
PCA9955ATW	16-channel Fm+ I^2C-bus 57 mA / 20 V constant current LED driver	0x02h for I^2C demo board (default setting)	U1
PRTR5V0U2AX	ESD protection diode	-	U2
LW-E67C	White LED	4 white LEDs	WHT_LED[1:4]
LRTB_G6SG	RGB LED	4 RGB LEDs	RGB_LED[1:4]
LTST-C170GKT	Green LED for PCA9955A power supply either 3.3 V or 5 V indicator	1 green LED	D1

8. PCA9955A evaluation steps

The PCA9955A is controlled by Win-I2CUSB GUI in Expert mode, as shown in Figure 7.

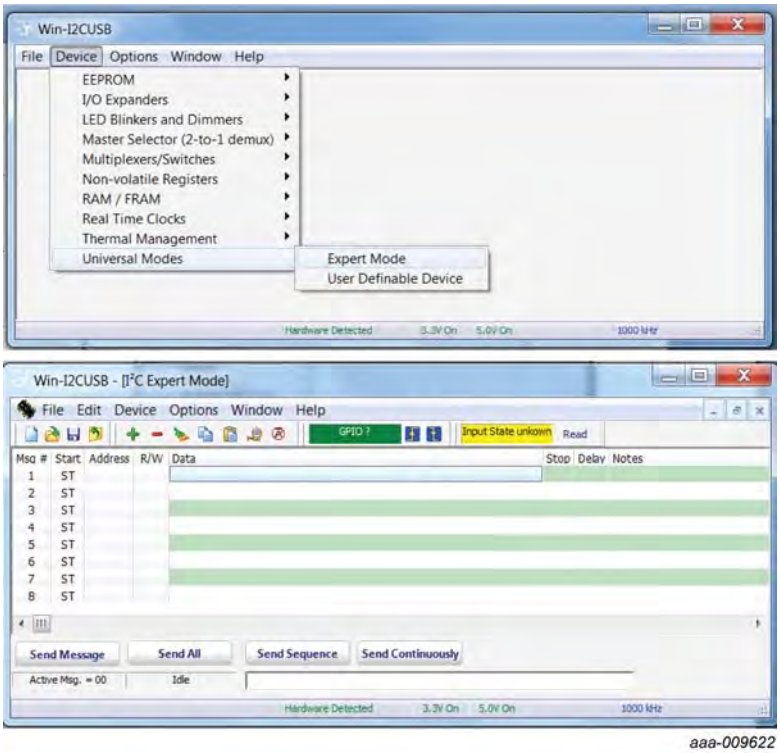

Fig 7. Drop-down menu selection for Expert mode

Connect the hardware as described in Section 4. All jumpers are in default setting and device address is set to 0x02 on J7, J9 and J10 (set AD[0:2] = GND) for PCA9955A demo board. When you have correctly installed the software and the demonstration board hardware is connected and recognized by the computer, start the Win-I2CUSB Lite

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software. As shown in Figure 7, when the demonstration board hardware is correctly connected to the USB port and the computer recognizes it, the message ‘Hardware Detected’ is displayed on the bottom of the window.

Switched 3.3 V and 5.0 V power supplies are controlled through the ‘Options’ menu or by double-clicking the 3.3 V or 5.0 V symbols on the bottom of the window. Power supplies are disabled by default and must be enabled before using the I^2C-bus devices on the board. I^2C-bus frequency is controlled through the ‘Options’ menu or by double-clicking the frequency symbol on the bottom of the window.

8.1 PCA9955A blinking demo for all White and RGB LEDs

1. From the ‘Device’ drop-down menus select ‘Universal Modes’, and from the subsequent drop-down menu select ‘Expert Mode’ as shown in Figure 7.
2. Copy the ‘PCA9955A WHT_RGB LEDs blinking demo i2c address = 0x02h’ text file as shown below. From the ‘File’ drop-down menus select ‘Open’, and from the ‘open data file’ window select the ‘PCA9955A WHT_RGB LEDs blinking demo i2c address = 0x02h’ text file.

```
Expert Mode Data File
00,Write,Yes,0,06,Comments: SW reset
02,Write,Yes,0,45,80,Comments: write IREFALL to 80h (225 uA x 128 = 28.8 mA per
     channel)
02,Write,Yes,500,82,01,01,01,01,Comments: start write LEDOUTx register to turn on
     white LEDs
02,Write,Yes,700,82,04,04,04,04,Comments: start write LEDOUTx register to turn on
     red LEDs
02,Write,Yes,500,82,01,01,01,01,Comments: start write LEDOUTx register to turn on
     white LEDs
02,Write,Yes,700,82,10,10,10,10,Comments: start write LEDOUTx register to turn on
     green LEDs
02,Write,Yes,500,82,01,01,01,01,Comments: start write LEDOUTx register to turn on
     white LEDs
02,Write,Yes,700,82,40,40,40,40,Comments: start write LEDOUTx register to turn on
     blue LEDs
02,Write,Yes,300,82,01,00,00,00,Comments: start write LEDOUTx register to turn on
     white LEDs
02,Write,Yes,300,82,00,05,00,00,Comments: start write LEDOUTx register to turn on
     white, red LEDs
02,Write,Yes,300,82,00,00,51,00,Comments: start write LEDOUTx register to turn on
     white, Blue_Green LEDs
02,Write,Yes,300,82,00,00,00,55,Comments: start write LEDOUTx register to turn on
     white and RGB LEDs
02,Write,Yes,400,82,40,01,04,10,Comments: start write LEDOUTx register to turn on
     white and RGB LEDs
02,Write,Yes,400,82,10,40,01,04,Comments: start write LEDOUTx register to turn on
     white and RGB LEDs
02,Write,Yes,400,82,04,10,40,01,Comments: start write LEDOUTx register to turn on
     white and RGB LEDs
02,Write,Yes,400,82,01,40,10,04,Comments: start write LEDOUTx register to turn on
     white and RGB LEDs
```


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```
02,Write,Yes,0,81,21,FF,FF,FF,FF,Comments: start write 01h register to program the
     DMBLNK=1 for blinking, LDRx=11 for group dimming/blinking controlled by
     GRPPWM, GRPFREQ
02,Write,Yes,0,44,C0,Comments: write PWMALL register to set the PWMx=C0h 75% duty
     cycles for individual LED
02,Write,Yes,2000,86,40,00,Comments: write GRPPWM=40h for duty cycle (ON/OFF ratio
     in 25%) and GRPFREQ= 00h (67 ms for blinking period)
02,Write,Yes,2000,86,80,01,Comments: write GRPPWM=80h for duty cycle (ON/OFF ratio
     in 50%) and GRPFREQ= 02h (131 ms for blinking period)
02,Write,Yes,2000,86,A0,02,Comments: write GRPPWM=C0h for duty cycle (ON/OFF ratio
     in 62.5%) and GRPFREQ= 04h (196 ms for blinking period)
02,Write,Yes,2000,86,C0,03,Comments: write GRPPWM=FFh for duty cycle (ON/OFF ratio
     in 75%) and GRPFREQ= 06h (262 ms for blinking period)
00,Write,Yes,0,06,Comments: SW reset
Sequence:01,02,03,04,05,06,07,08,09,10,11,12,13,14,15,16,17,18,19,20,21,22,23
```

3. After opening the ‘PCA9955A WHT_RGB LEDs blinking demo i2c address = 0x02h’ text file, the Win-I2CUSB GUI in Expert mode screen will be displayed as shown in Figure 8.
4. Click the ‘Send All’ button. All the valid messages on the screen is sent in order of the row number (Msg #). The action is performed one time.

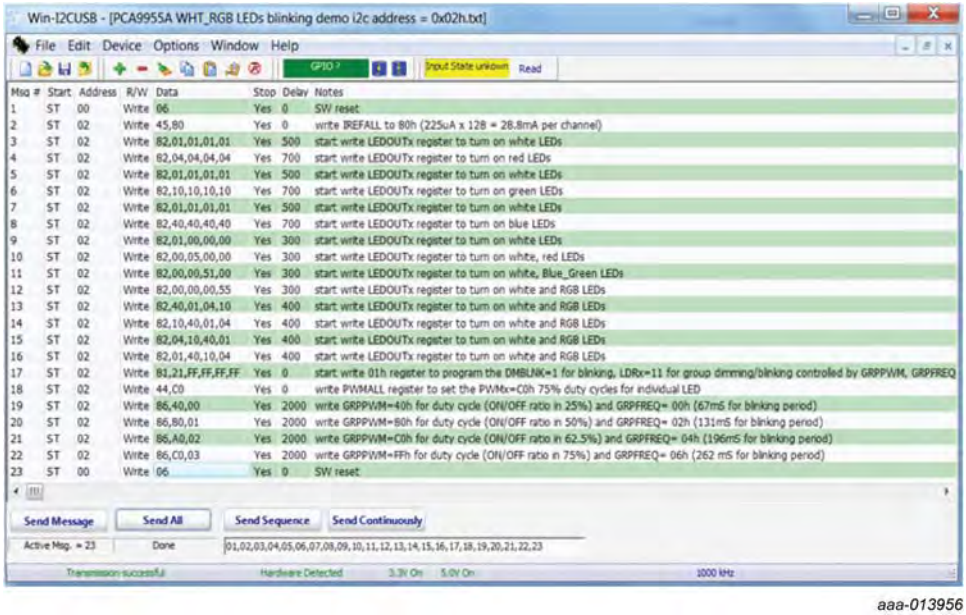

Fig 8. Message data in Expert mode to demonstrate all White and RGB LEDs for blinking

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8.2 Test of LED open or short error detection

The PCA9955A can detect an LED open or short condition at its open-drain LED outputs. Users recognize these faults by reading the status of a pair of error bits (ERRx) in error flag registers (EFLAGn) for each channel.

The user can poll the ERROR status bit (bit 6 in MODE2 register) to check if there is a fault condition in any of the 16 channels. The EFLAGn registers can then be read to determine which channels are at fault and the type of fault in those channels.

1. Copy the ‘PCA9955A Open or Short test’ text file as shown below. From the ‘File’ drop-down menus select ‘Open’, and from the ‘open data file’ window select the ‘PCA9955A Open or Short test’ text file.

```
Expert Mode Data File
00,Write,Yes,5,06,Comments: software reset
02,Write,Yes,0,98,80,80,Comments: set current to 50% of max in IREF0/IREF1
02,Write,Yes,50,02,05,Comments: set LED0 and LED1 are fully ON
02,Write,Yes,1,01,11,Comments: Clear all error status bits in EFLAGn registers by
     writing bit4=1 in MODE2
02,Read,Yes,0,01,Comments: read ERROR status (bit6) in MODE2
02,Write,Yes,0,46,Comments: set EFLAG0 register address
02,Read,Yes,0,00,Comments: Read EFLAG0 status (bit1/0 for LED 0 and bit 3/2 for
     LED1 error status)
02,Write,Yes,1,01,11,Comments: Clear all error status bits in EFLAGn registers by
     writing bit4=1 in MODE2
02,Write,Yes,0,98,00,00,Comments: set output current to zero in IREF0/IREF1
Sequence:01,02,03,04,05,06,07,08,09
```

2. After opening the ‘PCA9955A Open or Short test’ text file, the Win-I2CUSB GUI in Expert mode screen will be displayed as shown in Figure 9.
3. Click the ‘Send All’ button. All the valid messages on the screen is sent in order of the row number (Msg #). The action is performed one time.
4. To verify the read data on message line 5 for ERROR status and line 7 for EFLAG status.
5. To open the J12 and J16 for open-circuit test on LED0 and LED1, repeat steps 3 and 4 to find the error report in message line 5 and line 7.
6. To short the J15 and J17 for short-circuit test on LED0 and LED1, repeat steps 3 and 4 to find the error report in message line 5 and line 7.

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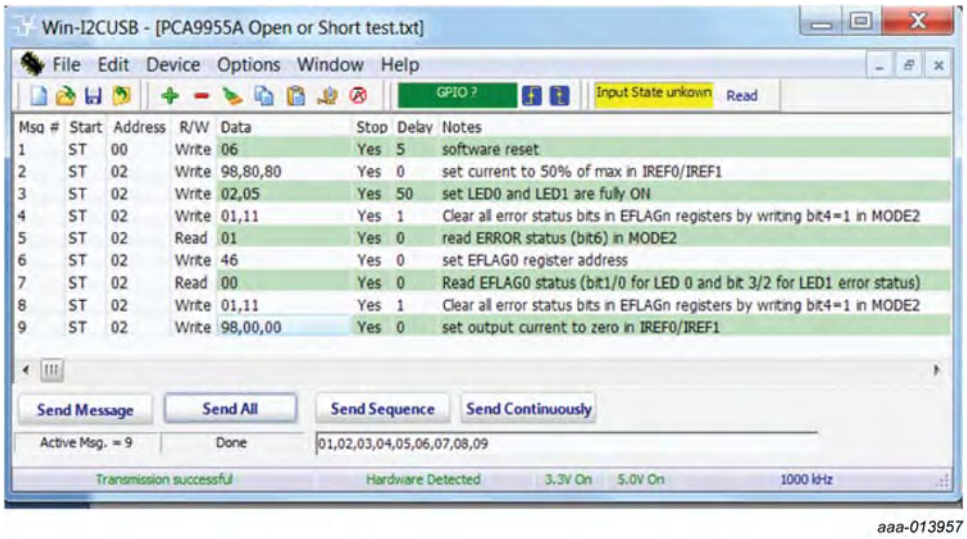
Win-I2CUSB - [PCA9955A Open or Short test.txt]
File Edit Device Options Window Help
GPIO ?
Input State unkown
Read
Msg # Start Address R/W Data Stop Delay Notes
1 ST 00 Write 06 Yes 5 software reset
2 ST 02 Write 98,80,80 Yes 0 set current to 50% of max in IREF0/IREF1
3 ST 02 Write 02,05 Yes 50 set LED0 and LED1 are fully ON
4 ST 02 Write 01,11 Yes 1 Clear all error status bits in EFLAGn registers by writing bit4=1 in MODE2
5 ST 02 Read 01 Yes 0 read ERROR status (bit6) in MODE2
6 ST 02 Write 46 Yes 0 set EFLAG0 register address
7 ST 02 Read 00 Yes 0 Read EFLAG0 status (bit1/0 for LED 0 and bit 3/2 for LED1 error status)
8 ST 02 Write 01,11 Yes 1 Clear all error status bits in EFLAGn registers by writing bit4=1 in MODE2
9 ST 02 Write 98,00,00 Yes 0 set output current to zero in IREF0/IREF1
Send Message
Send All
Send Sequence
Send Continuously
Active Msg. = 9
Done
01,02,03,04,05,06,07,08,09
Transmission successful
Hardware Detected
3.3V On
5.0V On
1000 kHz
aaa-013957

Fig 9. Example of Open or Short-circuit test for LED0 and LED1

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9. PCA9955A evaluation steps with Fm+ development board

The PCA9955A is controlled by Fm+ development board GUI in Expert mode, as shown in Figure 10.

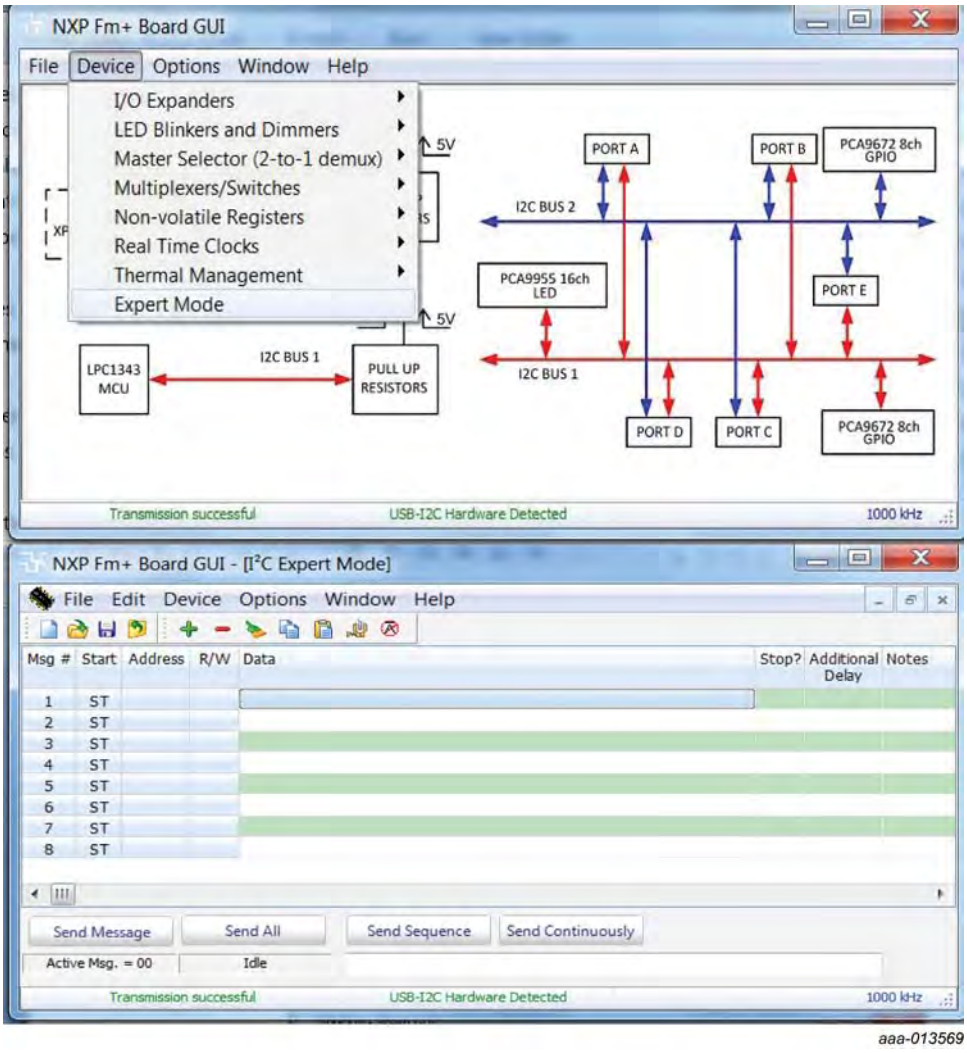

Fig 10. Select the Expert mode from Fm+ development board GUI

Connect the hardware as described in Section 4.3. All jumpers are in default setting and device address is set to 0x02 on J7, J9 and J10 (set AD[0:2] = GND) for PCA9955A demo board. When you have correctly installed the software and the demonstration board hardware is connected and recognized by the computer, start the Fm+ development board software. As shown in Figure 10, when the demonstration board hardware is correctly connected to the USB port and the computer recognizes it, the message 'USB-I2C Hardware Detected' is displayed on the bottom of the window.

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9.1 PCA9955A blinking and gradation demo for all LEDs

1. From the ‘Device’ drop-down menus select ‘Expert Modes’ as shown in Figure 10.
2. Copy the ‘PCA9955A WHT_RGB LEDs blinking & gradation demo i2c address = 0x02h’ text file as shown below. From the ‘File’ drop-down menus select ‘Open’, and from the ‘open data file’ window to select the ‘PCA9955A WHT_RGB LEDs blinking & gradation demo i2c address = 0x02h’ text file.

Expert Mode Data File

```
00,Write,Yes,0,06,Comments: SW reset
02,Write,Yes,0,45,80,Comments: write IREFALL to 80h (225uA x 128 = 28.8mA per
     channel)
02,Write,Yes,500,82,01,01,01,01,Comments: start write LEDOUTx register to turn on
     white LEDs
02,Write,Yes,700,82,04,04,04,04,Comments: start write LEDOUTx register to turn on
     red LEDs
02,Write,Yes,500,82,01,01,01,01,Comments: start write LEDOUTx register to turn on
     white LEDs
02,Write,Yes,700,82,10,10,10,10,Comments: start write LEDOUTx register to turn on
     green LEDs
02,Write,Yes,500,82,01,01,01,01,Comments: start write LEDOUTx register to turn on
     white LEDs
02,Write,Yes,700,82,40,40,40,40,Comments: start write LEDOUTx register to turn on
     blue LEDs
02,Write,Yes,300,82,01,00,00,00,Comments: start write LEDOUTx register to turn on
     white LEDs
02,Write,Yes,300,82,00,05,00,00,Comments: start write LEDOUTx register to turn on
     white, red LEDs
02,Write,Yes,300,82,00,00,51,00,Comments: start write LEDOUTx register to turn on
     white, Blue_Green LEDs
02,Write,Yes,300,82,00,00,00,55,Comments: start write LEDOUTx register to turn on
     white and RGB LEDs
02,Write,Yes,400,82,40,01,04,10,Comments: start write LEDOUTx register to turn on
     white and RGB LEDs
02,Write,Yes,400,82,10,40,01,04,Comments: start write LEDOUTx register to turn on
     white and RGB LEDs
02,Write,Yes,400,82,04,10,40,01,Comments: start write LEDOUTx register to turn on
     white and RGB LEDs
02,Write,Yes,400,82,01,40,10,04,Comments: start write LEDOUTx register to turn on
     white and RGB LEDs
02,Write,Yes,0,81,21,FF,FF,FF,FF,Comments: start write 01h register to program the
     DMBLNK=1 for blinking, LDRx=11 for group dimming/blinking controlled by
     GRPPWM, GRPFREQ
02,Write,Yes,0,44,C0,Comments: write PWMALL register to set the PWMx=C0h 75% duty
     cycles for individual LED
02,Write,Yes,2000,86,40,00,Comments: write GRPPWM=40h for duty cycle (ON/OFF ratio
     in 25%) and GRPFREQ= 00h (67mS for blinking period)
02,Write,Yes,2000,86,80,01,Comments: write GRPPWM=80h for duty cycle (ON/OFF ratio
     in 50%) and GRPFREQ= 02h (131mS for blinking period)
02,Write,Yes,2000,86,A0,02,Comments: write GRPPWM=C0h for duty cycle (ON/OFF ratio
     in 62.5%) and GRPFREQ= 04h (196mS for blinking period)
```


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```
02,Write,Yes,2000,86,C0,03,Comments: write GRPPWM=FFh for duty cycle (ON/OFF ratio
     in 75%) and GRPFREQ= 06h (262 mS for blinking period)
00,Write,Yes,0,06,Comments: write SW reset
02,Write,Yes,0,81,01,Comments: set linear curve
02,Write,Yes,0,82,05,05,05,05,Comments: set LDR= 01, turn white & red LED ON
02,Write,Yes,1,A8,C1,47,C9,78,00,00,00,00,00,00,00,00,00,00,00,33,33,00,00,00,
     00,03,Comments: set group0 in continuous mode, IREF_GRP=120x225=27mA,
     60-step, 64ms & 450ua per step, ramp up/dn time 3.9s & hold on/off (0.25s)
02,Write,Yes,8200,45,01,Comments: set IREFALL not 0 to enable LED outputs
00,Write,Yes,0,06,Comments: write SW reset
02,Write,Yes,1,81,05,Comments: set exponential curve
02,Write,Yes,0,82,11,11,11,11,Comments: set LDR= 01, turn white & green LED ON
02,Write,Yes,1,A8,C1,47,C9,78,00,00,00,00,00,00,00,00,00,00,00,55,55,00,00,00,
     00,03,Comments: set group0 in continuous mode, IREF_GRP=240x225=27mA,
     60-step, 64ms &450ua per step, ramp up/dn time 3.9s & hold on/off (0.25s)
02,Write,Yes,8200,45,01,Comments: set IREFALL not 0 to enable LED outputs
00,Write,Yes,0,06,Comments: write SW reset
02,Write,Yes,1,81,05,Comments: set exponential curve
02,Write,Yes,0,82,41,41,41,41,Comments: set LDR= 01, turn white & blue LED ON
02,Write,Yes,1,A8,C1,47,C9,78,00,00,00,00,00,00,00,00,00,00,00,99,99,00,00,00,
     00,03,Comments: set group0 in continuous mode, IREF_GRP=240x225=27mA,
     60-step, 64ms &450ua per step, ramp up/dn time 3.9s & hold on/off (0.25s)
02,Write,Yes,8200,45,01,Comments: set IREFALL not 0 to enable LED outputs
00,Write,Yes,0,06,Comments: write SW reset
Sequence:01,02,03,04,05,06,07,08,09,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,
     25,26,27,28,29,30,31,32,33,34,35,36,37,38
```

3. After opening the ‘PCA9955A WHT_RGB LEDs blinking & gradation demo i2c address = 0x02h’ text file, the ‘NXP Fm+ Board GUI’ in Expert mode screen is displayed as shown in Figure 11.
4. Click the ‘Send All’ button. All the valid messages on the screen will be sent in the order of the row number (Msg #). The action will be performed one time.

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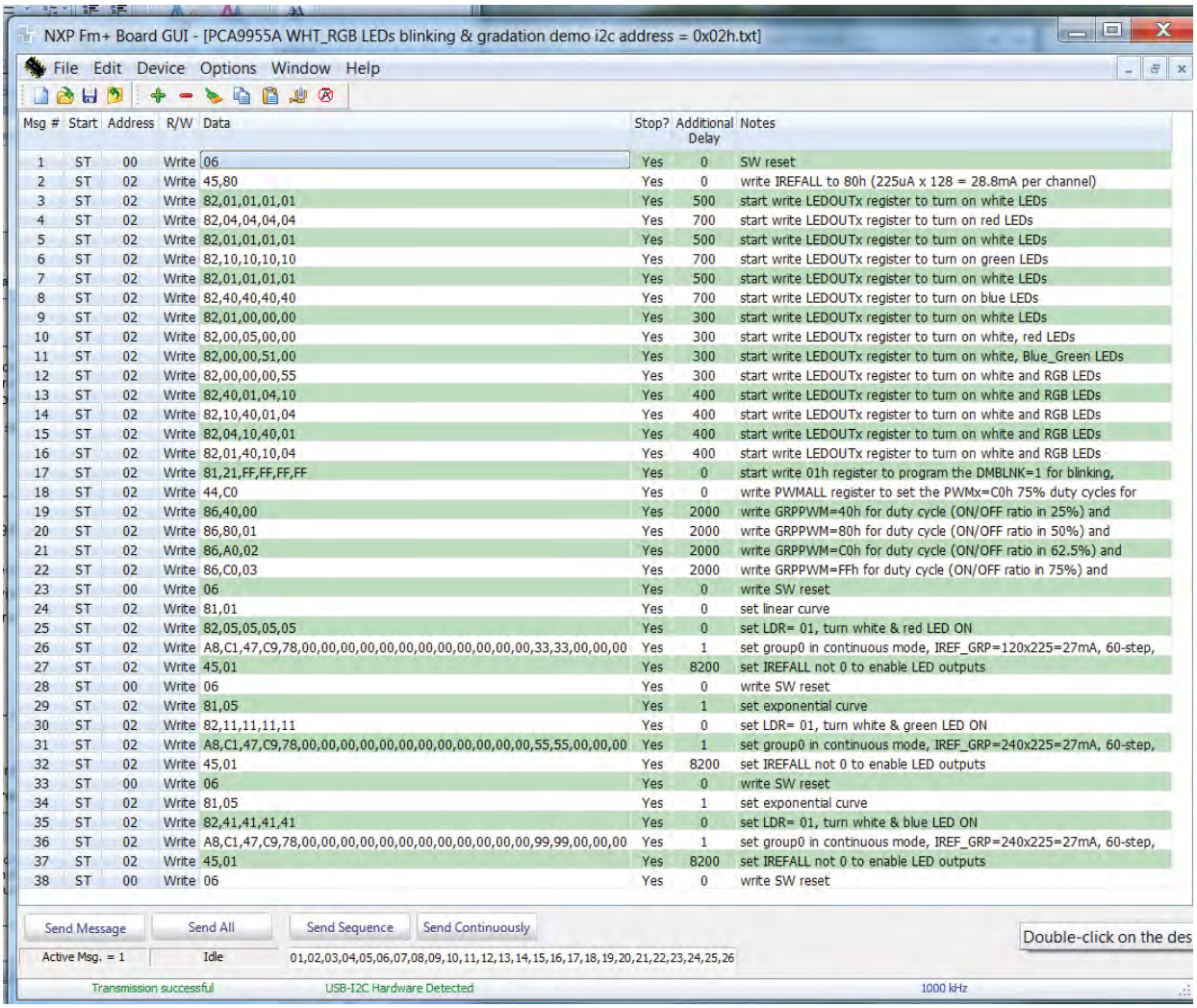

Msg #	Start	Address	R/W	Data	Stop?	Additional Delay	Notes
1	ST	00	Write	06	Yes	0	SW reset
2	ST	02	Write	45,80	Yes	0	write IREFALL to 80h (225uA x 128 = 28.8mA per channel)
3	ST	02	Write	82,01,01,01,01	Yes	500	start write LEDOUTx register to turn on white LEDs
4	ST	02	Write	82,04,04,04,04	Yes	700	start write LEDOUTx register to turn on red LEDs
5	ST	02	Write	82,01,01,01,01	Yes	500	start write LEDOUTx register to turn on white LEDs
6	ST	02	Write	82,10,10,10,10	Yes	700	start write LEDOUTx register to turn on green LEDs
7	ST	02	Write	82,01,01,01,01	Yes	500	start write LEDOUTx register to turn on white LEDs
8	ST	02	Write	82,40,40,40,40	Yes	700	start write LEDOUTx register to turn on blue LEDs
9	ST	02	Write	82,01,00,00,00	Yes	300	start write LEDOUTx register to turn on white LEDs
10	ST	02	Write	82,00,05,00,00	Yes	300	start write LEDOUTx register to turn on white, red LEDs
11	ST	02	Write	82,00,00,51,00	Yes	300	start write LEDOUTx register to turn on white, Blue_Green LEDs
12	ST	02	Write	82,00,00,00,55	Yes	300	start write LEDOUTx register to turn on white and RGB LEDs
13	ST	02	Write	82,40,01,04,10	Yes	400	start write LEDOUTx register to turn on white and RGB LEDs
14	ST	02	Write	82,10,40,01,04	Yes	400	start write LEDOUTx register to turn on white and RGB LEDs
15	ST	02	Write	82,04,10,40,01	Yes	400	start write LEDOUTx register to turn on white and RGB LEDs
16	ST	02	Write	82,01,40,10,04	Yes	400	start write LEDOUTx register to turn on white and RGB LEDs
17	ST	02	Write	81,21,FF,FF,FF,FF	Yes	0	start write 01h register to program the DMBLNK=1 for blinking,
18	ST	02	Write	44,C0	Yes	0	write PWMALL register to set the PWMx=C0h 75% duty cycles for
19	ST	02	Write	86,40,00	Yes	2000	write GRPPWM=40h for duty cycle (ON/OFF ratio in 25%) and
20	ST	02	Write	86,80,01	Yes	2000	write GRPPWM=80h for duty cycle (ON/OFF ratio in 50%) and
21	ST	02	Write	86,A0,02	Yes	2000	write GRPPWM=C0h for duty cycle (ON/OFF ratio in 62.5%) and
22	ST	02	Write	86,C0,03	Yes	2000	write GRPPWM=FFh for duty cycle (ON/OFF ratio in 75%) and
23	ST	00	Write	06	Yes	0	write SW reset
24	ST	02	Write	81,01	Yes	0	set linear curve
25	ST	02	Write	82,05,05,05,05	Yes	0	set LDR= 01, turn white & red LED ON
26	ST	02	Write	A8,C1,47,C9,78,00,00,00,00,00,00,00,00,00,00,00,00,33,33,00,00,00	Yes	1	set group0 in continuous mode, IREF_GRP=120x225=27mA, 60-step,
27	ST	02	Write	45,01	Yes	8200	set IREFALL not 0 to enable LED outputs
28	ST	00	Write	06	Yes	0	write SW reset
29	ST	02	Write	81,05	Yes	1	set exponential curve
30	ST	02	Write	82,11,11,11,11	Yes	0	set LDR= 01, turn white & green LED ON
31	ST	02	Write	A8,C1,47,C9,78,00,00,00,00,00,00,00,00,00,00,00,00,55,55,00,00,00	Yes	1	set group0 in continuous mode, IREF_GRP=240x225=27mA, 60-step,
32	ST	02	Write	45,01	Yes	8200	set IREFALL not 0 to enable LED outputs
33	ST	00	Write	06	Yes	0	write SW reset
34	ST	02	Write	81,05	Yes	1	set exponential curve
35	ST	02	Write	82,41,41,41,41	Yes	0	set LDR= 01, turn white & blue LED ON
36	ST	02	Write	A8,C1,47,C9,78,00,00,00,00,00,00,00,00,00,00,00,00,99,99,00,00,00	Yes	1	set group0 in continuous mode, IREF_GRP=240x225=27mA, 60-step,
37	ST	02	Write	45,01	Yes	8200	set IREFALL not 0 to enable LED outputs
38	ST	00	Write	06	Yes	0	write SW reset

aaa-014228

Fig 11. Message data in Expert mode to demo all White and RGB LEDs for blinking and gradation

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10. Support

For support, send an e-mail to: **i2c.support@nxp.com**

11. Abbreviations

Table 3. Abbreviations

Acronym	Description
ESD	ElectroStatic Discharge
Fm+	Fast-mode Plus
GUI	Graphical User Interface
I^2C-bus	Inter-Integrated Circuit bus
IC	Integrated Circuit
LED	Light Emitting Diode
PC	Personal Computer
PWM	Pulse Width Modulator
RAM	Random Access Memory
RGB	Red/Green/Blue
RGBA	Red/Green/Blue/Amber
SMBus	System Management Bus
USB	Universal Serial Bus

12. References

[1] **PCA9955A, 16-channel Fm+ I^2C-bus 57 mA / 20 V constant current LED driver —** Product data sheet; NXP Semiconductors; www.nxp.com/documents/data_sheet/PCA9955A.pdf

[2] **UM10206, I2C Demonstration Board 2005-1 Quick Start Guide —** NXP Semiconductors; www.nxp.com/documents/user_manual/UM10206.pdf

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